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DETERMINATION OF THE EFFECTIVENESS OF NANO SILVER ADDITIVE AQUEOUS EXTRACT OF *Moringa oleifera* L. (Brassicales: Moringaceae) AGAINST ROOT LESION NEMATODE [*Pratylenchus thornei* Sher & Allen) Chitwood (Nematoda: Pratylenchidae)] UNDER LABORATORY CONDITIONS

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Pratylenchus thornei (Sher and Allen) Chitwood (Nematoda: Pratylenchidae) is widespread species and caused important damage on cereals, legumes, ornamental plants and vegetables. *P. thornei* is migratory endoparasitic nematode, which migrate through root tissue and causing extensive root damage. The objective of study was to determine the effectiveness of nano silver additive aqueous extract of *Moringa oleifera* L. (Brassicales: Moringaceae) against *P. thornei* under laboratory conditions. *P. thornei* was produced on carrot culture. Nematodes were extracted by petri dish methods and keeping them until using at 4°C. *P. thornei* suspensions were transferred to 24 cell plate which had approximately 50±5 nematodes each cell in 100 µl. Nano silver additive aqueous extract of *M. oleifera* was prepared and added to each cell at 4 concentrations (168, 84, 42 and 21 ppm) in 1 ml. Distilled water was used as a control. All dishes were kept at 28±2°C. The nematode exposed 24, 48, 72 and 96 hours in four concentration of *M. oleifera*. *P. thornei* were considered dead if they did not move when probed with a fine needle. As a result of this experiment, in 48 hours, 168 ppm (90.55±1.74) and 84 ppm (79.79±1.89) showed highly promising mortality. Nano silver additive aqueous extract of *M. oleifera* was found effective in reducing *P. thornei*.
Keywords: Parasitic nematodes, *Pratylenchus* spp., root damage, nematicides, plant extract, biopesticies, glucosinolate, $AgNO_3$.

INTRODUCTION

Plant parasitic nematodes are one of the important problems in agricultural crop production. Their damage has been estimated at $US 80 billion per year (Nicol *et al*., 2011). *Pratylenchus* species has been the greatest impact on legumes, cereals, maize, potatoes, vegetables, and fruit trees after root-knot and cyst nematodes in the rank of third all around the world (Castillo and Volvas, 2007). *Pratylenchus* spp. cause root damage such as lesions and necrotic areas. It is difficult to manage them because of a wide range of host plants. Their control by chemical pesticides are existing but many pesticides are synthetics. Environmental concerns, the effect of human health and non-target organisms are worked on the development of alternative methods for managing plant-parasitic nematodes. Many studies reported that plant extracts have been shown nematicidal activities (Bala *et al.*,1986; Nandal and Bhatti, 1986; Malik *et al.*, 1988; Coffey, 1993; Chitwood, 2002; Wang *et al.*, 2002; Ntalli *et al.*, 2011). Numerous plant species, representing 57 families, have been shown to contain nematicidal compounds (Sukul, 1992). Brassicaceae, Caricaceae, Salvadoraceae, Tropaeolaceae, and Moringaceae family's plants have high glucosinolate which have a biofumigation effect on the pests (Angus *et al.*, 1994; Morra and Kirkegaard, 2002; Morra, 2004). Glucosinolates are naturally occurring sulphur compounds that occur in plants as secondary metabolites (van Dam *et al.*, 2009).

Moringaceae family has a single genus *Moringa* which is further characterized by 13 species. *Moringa* spp. are rich sources of various phytochemicals including uncommon sugar-modified glucosinolates (Bennett *et al.*, 2003). *Moringa* species are used for many purposes such as the possible sources of biodiesel (Rashid *et al.*, 2008), food industries (contain edible oil), perfume industry and medicinal purposes (Foidl *et al.*, 2001). Besides these, pesticide properties are studied by different researchers (Prabhu *et al.*, 2011; Anita, 2012; El-Mohamedy and Abdalla, 2014).

The objective of this study was to determine the effectiveness of nano silver additive aqueous extract of *Moringa oleifera* L. (Brassicales: Moringaceae) against root lesion nematode [*Pratylenchus thornei* Sher & Allen) Chitwood (Nematoda: Pratylenchidae)] under laboratory conditions.

MATERIALS AND METHODS

***Nematodes*:** *Pratylenchus thornei* was produced on carrot culture at Kirsehir Ahi Evran University (Kirsehir, Turkey). Nematode juveniles were extracted from carrot discs by using the Petri Dish methods and kept at 4°C until used in the experiment.

***Plant material and preparation of aqueous extracts*:** *Moringa oleifera* was collected from Yalova, Turkey. The plant leaves were air-dried at room temperature in dark conditions. The dried plant parts were milled to a fine powder in a mill. Dry leaves powder was weighed 10 g and then added 100 ml distilled water. This *Moringa* aqueous extract was filtered through filter paper and stored in the refrigerator in a dark bottle at 4°C until used in the experiment (Nartop, 2017). This solution was treated as stock. The dilutions were made from this solution.

***Preparation of nano silver additive aqueous extract of Moringa oleifera*:** 168 mg $AgNO_3$ was dissolved at 900 ml distilled water. *M. oleifera* stock solution was added and then kept in the hot water bath until the colour change was observed (Nartop, 2017). This solution was kept in the refrigerator in a dark bottle at 4°C until used in the experiment.

***Effect of nano silver additive aqueous extract of Moringa oleifera on mortality of Pratylenchus thornei*:** 100µl of *P. thornei* suspension, containing 50±5 adults and juveniles (J2s) ml^{-1}, was added to 4 different concentrations of 21 ppm (0.125 mM), 42 ppm (0.25 mM), 84 ppm (0.50 mM), and 168 ppm (1 mM) *M. oleifera* solutions (each petri dish had total 1 ml). The experiment was set up with three replicates and repeated two times. Distilled water was used as control. The cultures were incubated at 28±2°C. The mortality of juveniles was evaluated after 24, 48, 72 and 96 hrs. Nematode juveniles were considered dead if they did not move when probed with a fine needle (Abbasi *et al*., 2008).

Statistical analysis: Data were analysed by analysis of variance, and means were compared using Duncan's Multiple Range test (SPSS, 1999).

RESULTS AND DISCUSSION

The study showed that nano silver additive aqueous extract of *M. oleifera* was highly toxic against *P. thornei* in an exposure. More than 60% of nematodes were recorded dead after 24 hrs by a dose of 168 and 84 ppm. An increase in mortality was observed with time. In 96 hrs, more than 90% of nematodes were dead compared with control (Fig. 1).

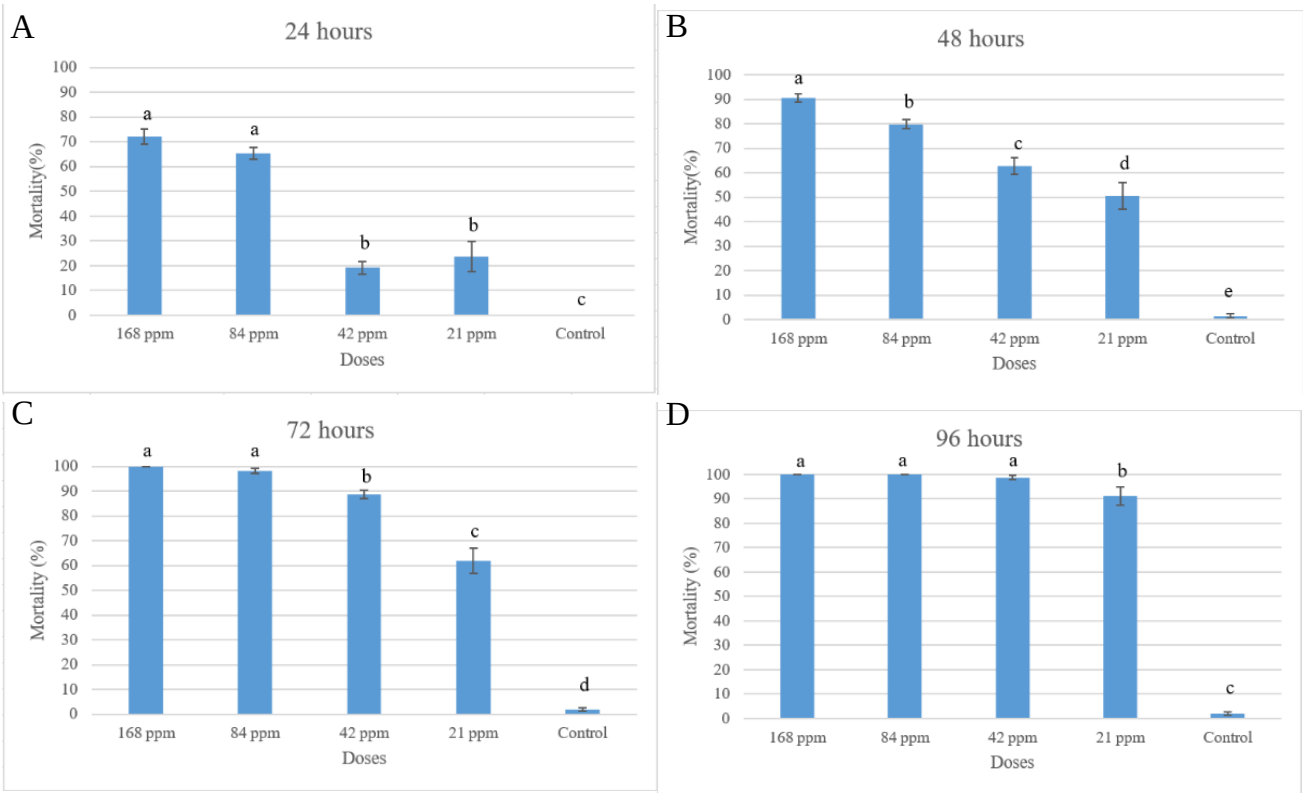

Figure 1. Effect of nano silver additive aqueous extract *of Moringa oleifera* on mortality of *Pratylenchus thornei*: A- 24 hours after inoculation, B- 48 hours after inoculation, C- 72 hours after inoculation, D- 96 hours after inoculation.

Many plants species are reported to possess pest management properties such as insecticidal effect, antifeeding, repellent, growth-inhibiting, nematicide effect, herbicide effect, and anti-fungal effect (Bala *et al.*,1986; Nandal and Bhatti, 1986; Malik *et al.*, 1988; Coffey, 1993; Wang *et al.*, 2002; Ntalli *et al.*, 2011). Many compounds such as dithioacetylenes, glycosides, glucosinolates have been found in different plants species which have nematicidal activities against *Pratylenchus* spp. (Ferraz and De Freitas, 2004). Aqueous extracts of the tree *Quillaja saponaria* Molina, containing triterpenoid, saponins, polyphenols, salts and sugars, have been tested against *Pratylenchus neglectus* and *P. thornei* in Chile (San Martin and Magunacelaya, 2005). *M. oleifera* has glucosinolates, which in this study showed nematicidal activity against *P. thornei.* Rombati *et al.* (1999) reported that *Acorus calamus* L. showed nematicidal activity against *P. thornei* and mortality of the nematode increased with increase in exposure period from 6-48 hrs. Nematode mortality was increased with an increase in the exposure period even at low doses too.

The study concludes that nano silver additive aqueous extract of *Moringa oleifera* L. is a good inhibitor of nematode and is suggested as a potential substitute for synthetic nematicides used in the management of *P.thornei* in the agricultural crop growing areas.

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